The Structure of Red Blood Cell's Aggregates

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Red Blood Cells (RBCs) aggregate in blood plasma due to presence of proteins like fibrinogen, immunoglobulin M and C-reactive protein. The characteristic face-to-face morphology of RBC's aggregates is similar to stacks of coins, which is often referred to as rouleaux. [1] In vitro rheological properties of blood as well as in vivo flow dynamics and flow resistance of blood are influenced by RBC aggregation. [2]
The first step in understating rouleaux formation is the aggregation of two RBCs, which is called doublet. The formation and shape of a doublet is governed by bending and shear elasticity and adhesion energy of RBCs. [3]
We induce aggregation of RBCs by adding different type of particles to RBCs dispersed in a density matching buffer. The ideal long rage attraction is induced by rod-like *fd*-viruses. Rode-like *fd*-viruses with a high length to diameter ratio are used as a depletant agent. [4] The depletion interaction is tuned by varying the concentration of the *fd*-virus which results in different shape of the doublets. We employ ultra-fast confocal microscope to image the RBC's aggregates to investigate the 3D shape of doublets.
We observe transition between line contacted doublets, where RBCs do not deform but touch along a circle, to doublets, where individual RBCs deform and are in full contact.

References

[1] Oguz Baskurt, Björn Neu, and Herbert J Meiselman. *Red blood cell aggregation*. CRC Press, 2011.

[2] Björn Neu and Herbert J Meiselman. Depletion-mediated red blood cell aggregation in polymer solutions. *Biophysical journal*, 83(5):2482–2490, 2002.

[3] Masoud Hoore, François Yaya, Thomas Podgorski, Christian Wagner, Gerhard Gompper, and Dmitry A Fedosov. Effect of spectrin network elasticity on the shapes of erythrocyte doublets. *Soft matter*, 14(30):6278–6289, 2018.

[4] D Guu, JKG Dhont, GA Vliegenthart, and MP Lettinga. Depletion induced clustering in mixtures of colloidal spheres and fd-virus. *Journal of Physics: Condensed Matter*, 24(46):464101, 2012.